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RESEARCH ARTICLE

Analysis of functionality in patients with post-COVID-19 pain

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Abstract

Background: COVID-19, caused by the SARS-CoV-2 virus, resulted in millions of deaths and affected individuals indiscriminately. "Long COVID" presents persistent manifestations, such as pain, fatigue and cognitive problems. **Objective:** To analyze whether patients suffering from post-COVID-19 pain had an impact on their functionality. **Methods:** Cross-sectional observational study involving one hundred and three participants, between 18 and 59 years old, with post-COVID-19 pain complaints. A structured questionnaire, pain threshold assessment, dynamometry and functional capacity tests were applied. The Visual Analogue Scale (VAS) and post-COVID-19 functional status (PCFS) measured pain and functional status, respectively. **Results:** Data analysis showed a significant correlation between Visual Analogue Scale (VAS) and PCFS, dynamometry and lifting score. Age was statistically correlated with PCFS, with the score for sitting and standing, indicating worse performance in the activity of getting up with age. **Conclusion:** Post-COVID-19 musculoskeletal pain is linked to reduced functionality and muscle strength, compromising daily activities and quality of life. It can also be concluded that there is a need for preventive and rehabilitative strategies for persistent symptoms in post-COVID-19 patients.

Keywords: Pain; functional physical performance; acute post-COVID syndrome.

BACKGROUND

The COVID-19 pandemic, caused by the SARS-CoV-2 virus, emerged in December 2019 in Wuhan, Hubei province, China[(1)]. The rapid spread of SARS-CoV-2 led the World Health Organization (WHO) to proclaim a global pandemic on March 11, 2020[(2)]. COVID-19 is characterized as a pathogenesis disease complex and has been a major public health challenge worldwide[(1)]. After remission, apparently healthy individuals may present various clinical manifestations and peripheral and central inflammatory responses that generally lead to long-lasting musculoskeletal changes and functional impairment, characterizing the term "Long COVID"[(3)]. Among the symptoms reported in "Long COVID," an intriguing and increasingly observed manifestation is the persistence of post-COVID-19 pain, associated with persistent fatigue or mood changes, cognitive changes, or persistent respiratory disorders[(4)].

A comprehensive analysis in 2022 shows a picture of persistent musculoskeletal pain in patients after COVID-19. It indicates that chronic pain worsened in 53% of patients, and this worsening was observed in individuals in whom biological and psychosocial factors were associated[(5)]. Therefore, symptoms, such as joint pain, chest

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pain, and headache, are considered persistent long-term sequelae(6). Pain manifestations caused by the disease in post-covid patients are aggravated due to the installed inflammatory process. Pain can negatively impact people's ability to perform activities of daily living (ADL), causing immobility, which is increasingly more present in these individuals, as the decrease in voluntary movement is a protective mechanism in the presence of pain, consequently causing loss of functionality.

Bodily functionality describes everything the body can do, comprising not only the domains of physical capabilities and internal processes but also the domains of creative efforts, bodily senses and sensations, communication with other individuals, and self-care(7). With the long-term impact of COVID-19, it is known that the disease leads to limited functionality in individuals who have been infected(8). A preliminary study demonstrated impairments in physical functioning and ADL performance upon hospital discharge(9). Patients infected with COVID-19 demonstrated a 47.5% reduction in functional status six months after hospitalization(10). Still in this context, it was observed that mobility, life activities, and participation were the domains most compromised by the disease, with 42% having moderate to extreme difficulty standing for long periods, 40% walking a long distance, 37% in everyday work/school responsibilities, 31% in participating in community activities and 51% emotionally affected by their health problems(11).

In addition to being a persistent symptom during infection, pain is one of the most prevalent long-term sequelae. However, more studies are needed on the persistence of pain manifestations after COVID-19(12). The objective of the present study was to analyze whether patients suffering from post-COVID-19 pain impacted their functionality in order to discover different aspects such as the intensity and region affected by the pain, relief factors, and pain worsening. , decreased functional capacity, and impact of pain on quality of life. The information collected could support new research and the prevention and rehabilitation of patients with pain and deficits in physical function after COVID-19.

METHODS

An observational, cross-sectional study was carried out, with a descriptive and exploratory analytical approach.The research was conducted at the Pain Neuromodulation and Sensorimotor Performance Laboratory (LANDS) at the Federal University of Delta do Parnaíba (UFDPar), approved by the Research Ethics Committee of the Federal University of Delta do Piauí under opinion No. 5,414,525. This study followed the recommendations of Strengthening the Reporting of Observational Studies in Epidemiology (STROBE)(13). The study included a carefully selected group of one hundred and three participants, both sexes, aged between 18 and 59 years. These participants had specific pain complaints after Sars-Cov-2 infection, were between 3 and 12 months post-COVID-19, and had been vaccinated against COVID-19 with at least 2 doses. Importantly, these participants had not undergone rehabilitation to treat pain during this period. The study excluded patients with pain complaints related to previously diagnosed pathologies, those who do not reside in Parnaíba/PI, And those with psychological, emotional, neurological, or intellectual impairment that made it impossible to respond to the methodological instruments applied. Patients with incomplete data or a history of pneumonia, flu accompanied by fever, body aches or diarrhea and anosmia for less than 15 days were also excluded.

Research and data collection

According to the inclusion criteria, participants were captured through the "Flu Syndrome (GS) investigation forms suspected of Coronavirus disease 2019", valid throughout the national territory for reporting COVID-19 cases in each municipality, made available by the Epidemiological Secretariat of Parnaíba (PI), Brazil. They were contacted and informed about the study and invited to attend the Pain Neuromodulation and Sensorimotor Performance Laboratory (LANDS) at the Federal University of Delta do Parnaíba (UFDPar), with a scheduled time and date, complying with the safety protocols of the Ministry of Health (MS) (BRAZIL, 2020). After explanation and guidance about the study, participants signed the Free and Informed Consent Form (TCLE), and the methodological instruments were applied.

Initial assessment

To obtain sociodemographic and clinical data not included in the notification form, an unstructured questionnaire was applied to personal data, sociodemographic, behavioral, and clinical characteristics, such as date of birth, weight, and height, through which the Body Mass Index (BMI), time after COVID-19, physical activity before and after COVID-19, smoking, alcohol consumption, previous comorbidities, date of positive test for COVID-19, symptoms presented, sequelae, hospitalization, immunization for COVID-19, number of doses, presence of reinfection with Sars-Cov-2, drug and non-drug treatment for pain complaints, duration of pain and the affected region, as well as mitigating and aggravating factors.

Scales, questionnaires and tests

The Visual Analogue Scale (VAS) was used to measure the patients' pain intensity. This scale ranges from (0-10), with zero being considered no pain and 10 being the worst possible pain(14). The pain threshold is understood as the minimum limit at which the body perceives the presence of pain and was assessed using a manual pressure algometer test. The test consisted of positioning the tip of the instrument, a WAGNER IINSTRUMENT algometer, model Force Ten™ FDX 10, perpendicular to the patient's skin, on the dominant arm, over the tendon of the extensor carpi brevis muscle, 2 cm distal to the lateral epicondyle. Subsequently, the patient was instructed to say "stop" when perceiving the first painful sensation arising from the mechanical stimulus. The procedure was repeated 3 times(15,16).

Dynamometry, based on grip strength, was used to assess patients' muscular strength, it is the simplest and least complicated of a multitude of instrumental measurements of muscular strength, some evidence, although inconsistent, shows that grip strength tends to reflect muscle strength(17). Muscular strength is generated mainly by the flexor muscles of the hand and forearm(18). The patients remained seated with their arms at their sides with the elbow flexed at 90°, the forearm in the prone position and the wrist in a neutral position. With the standard verbal stimulus, individuals held the dynamometer with maximum effort. According to the grip strength assessment protocols most used in the literature, the maximum value of three repetitions on the dominant side was measured (with 30 seconds of rest between attempts) and recorded in kg(19).

The 1-minute sit-to-stand test was used to evaluate the functional capacity and muscle strength of the patients' lower limbs. Its execution was carried out on flat, non-slippery ground. The patient was instructed to remove shoes and objects that could compromise performance in the test and was then instructed to sit and stand up with as little support as possible and trying not to become unbalanced. The patient was positioned standing, facing away from the mats previously positioned on the floor. Thus, the examiner positioned himself slightly behind the patient in order to avoid any accidents, asked the patient to perform the sitting movement, lasting 1 minute, and observed him. The test ended with the movement of standing up with as little imbalance and support as possible. For the interpretation of the test, a score of 5 was given for the act of sitting and 5 for standing up, thus, for each imbalance there was a reduction of half a point and, for each support, there was a withdrawal of one point(20).

The Post-COVID-19 Functional Status Scale (PCFS) was used to assess the patient's functional status, thus stratifying functional status limitation as follows: grade 0 (no functional limitations), grade 1 (insignificant functional limitations) , grade 2 (mild functional limitations), grade 3 (moderate functional limitations), grade 4 (severe functional limitations), and grade 5 (death)(21). This scale was recently translated into Brazilian Portuguese and has been an excellent strategy for assessing limitations after SARS-COv-2 infection. The PCFS scale covers the full range of functional outcomes, as it focuses on limitations in daily tasks/activities at home or at work/school, as well as changes in lifestyle(22).

Statistical analysis

For statistical analyzes and creation of graphs, the GraphPad Prism 5.0 program was used. Descriptive and analytical analyzes were performed to verify the functionality of patients with pain after COVID-19 infection and differences in primary and secondary variables. The results were expressed as mean and standard deviation (variables with normal presentation) and median and interquartile range (variables with non-normal distribution), minimum and maximum. To verify the degree of association between the variables, Spearman correlation was used. Data normality was assessed using the Liliefors test. Comparisons with $p<0.05$ were considered significant.

RESULTS

One hundred three patients were included, 84 (81.6%) female, with a mean age of 39.0 ± 11.4, considering the adult age group. Table 1 shows the values referring to the Visual Analogue Scale (VAS), the post-COVID-19 functional status scale (PCFS), dynamometry, and the score for sitting and standing assessed from the 1-minute sit-to-stand test (1-MSTST).

Table 01. Central tendency and dispersion values of age, VAS, PCFS Degree, Dynamometry, and Score for sitting and Score for standing

n = 103		Minimum-maximum
Age (years)[1]	39,0±11,4	18 – 59
EVA [2]	5,0±4,0	1,0 – 10,0
PCFS degree [2]	2,0±1,0	0 – 4
Dynamometry (major)[2]	12,1±7,1	2,2 – 37,2
Dynamometry (mean)[2]	10,8±6,5	1,9 – 35,0
Note to sit[2]	4,5±0,3	0 – 5
Note to pick up[2]	*4,0±1,0*	*0 – 5*

Note: 1 mean ± standard deviation; 2 median ± Interquartile range; VAS: Visual Analogue Scale; PCFS: Post-COVID-19 Functional Status Scale

In Table 2, the values referring to VAS (pain) and Age were associated with the other study variables. When relating the functional status of the evaluated individuals (PCFS) to the data obtained through the VAS, the p-value found was <0.05. Figure 1 elucidates the correlation between EVA and the average and highest dynamometry values. It is observed that, in the correlation of EVA and dynamometry (highest), r=-0.3511 and in the correlation of EVA and dynamometry (average), r=-0.3559, showing the lower performance in grip strength according to the increase in pain. By correlating the VAS and the score for getting up (1-MSTST), it was observed that the performance for getting up had greater statistical significance when compared to the performance for sitting (p=0.0085).

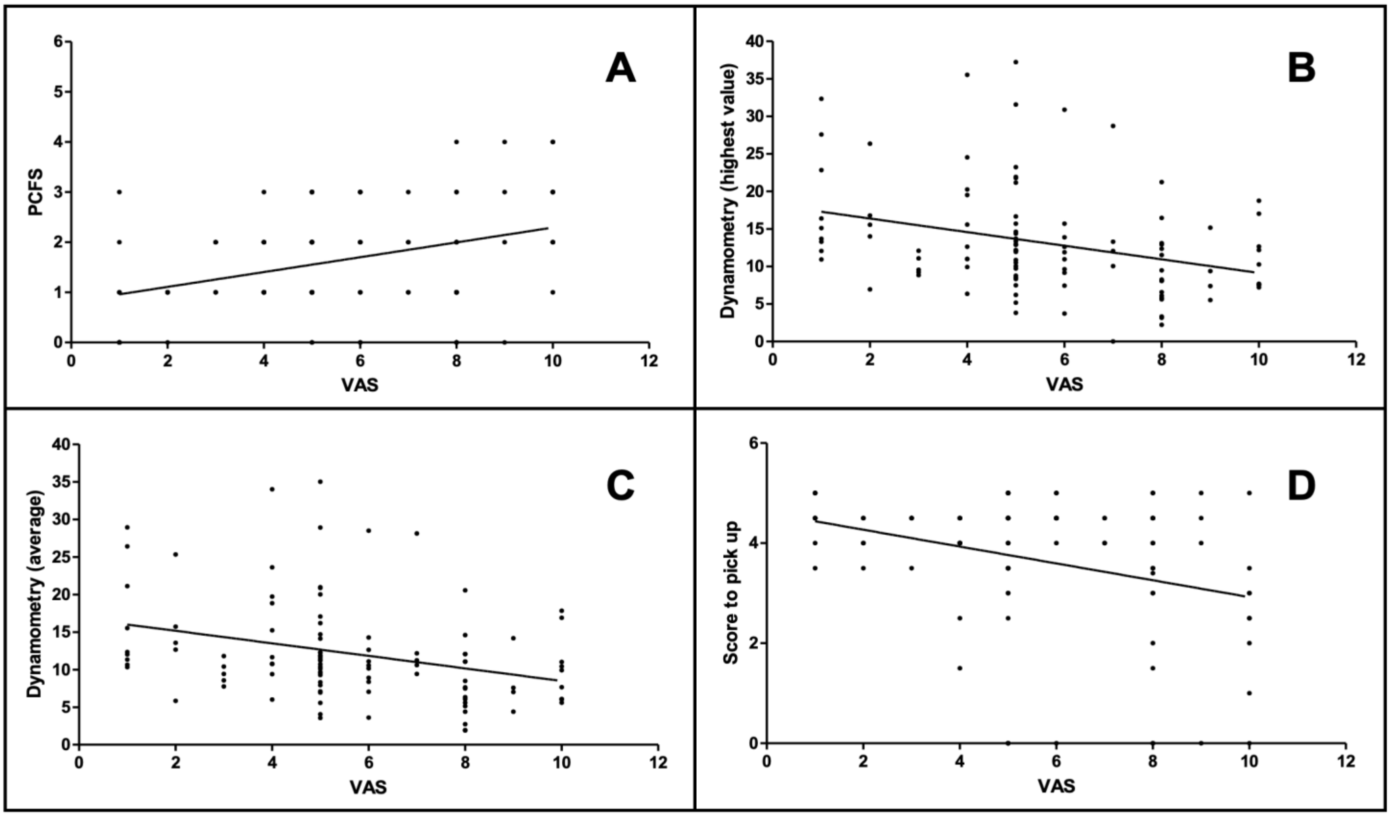

Figure 1. Scatter diagrams between EVA

(A) PCFS (Spearman Correlation; r = 0.3174, p = 0.0011); (B) Dynamometry (higher) (Spearman Correlation; r = -0.3511, p = 0.0003); (C) Dynamometry (average) (Spearman correlation; r = -0.3559, p = 0.0002); (D) Score for lifting (Spearman Correlation; r = -0.2578, p = 0.0085)

From the analysis of the correlation of the age variable (expressed in years) with other variables investigated in the study, statistically, little relevance was noted in the results of average dynamometry and greater dynamometry (p >0.05). The PCFS variable and the sitting score presented p <0.05. However, the results obtained from the PCFS and correlated with the VAS (pain) were potentially more significant. Figure 2 expresses the relevant relationship between the score for lifting and the age variable (p=0.0026), demonstrating worse performance in this activity according to age progression.

Table 02. Assessments of association between VAS (pain) and Age with the other study variables

n=103	r (Spearman)	p-value (Spearman)
EVA (pain)		
PCFS degree	0,3174	0,0011
Dynamometry (major)	−0,3511	0,0003
Dynamometry (average)	−0,3559	0,0002
Note to sit	−0,0976	0,3789
Note to pick up	−0,2578	0,0085
Age (years)		
PCFS degree	0,2015	0,0411
Dynamometry (major)	−0,1544	0,1194
Dynamometry (average)	−0,1039	0,2960
Note to sit	−0,2148	0,0293
Note to pick up	−0,2930	0,0026

Note: *PCFS:* Post-COVID-19 Functional Status Scale

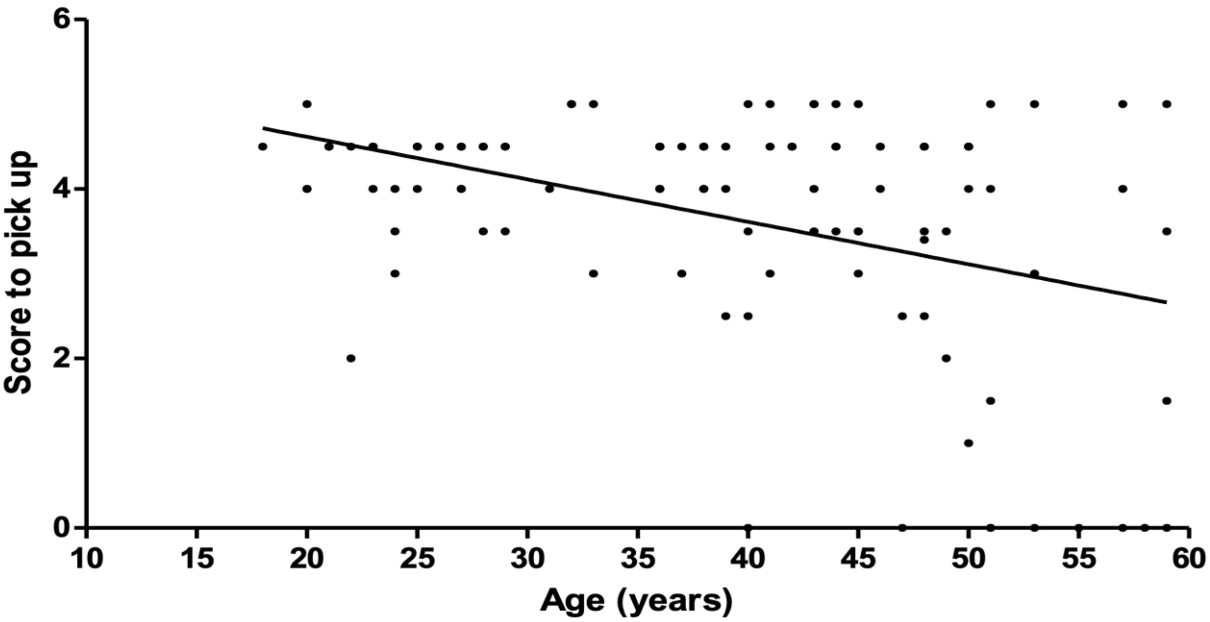

Figure 2. Scatter diagram between Age and Grade to raise (Spearman Correlation; r = -0.2930, p = 0.0026)

DISCUSSION

The study results show that functionality expressed through the PCFS scale, which reflects individuals' activity limitations, is influenced by the pain present in post-COVID-19 musculoskeletal repercussions. Therefore, the performance of ADLs and functional capacity were significantly impaired in participants who reported pain. Pain is an important symptom experienced in viral illnesses. As with many infections, it has been common in SARS-CoV-2 contagion[23]. In some cases, this manifestation is observed only during the infectious process, ceasing when the disease is cured and the virus disappears. However, in other scenarios, it can remain in the individual even after infection. Studies show that up to 18% of infected individuals with post-COVID symptoms experienced pain during the first year after the end of the disease[23]. Therefore, other limitations arise due to the persistence of this condition, such as the reduction in muscle strength, assessed in the present study using dynamometry. It was evident that the greater the degree of pain reported by the individual on the VAS, the more significant the reduction in handgrip strength recorded by the device.

Similar results were demonstrated in a retrospective study, where despite the record of improvement in muscle strength in the 4th month after COVID-19 infection, functional limitations related to this variable persisted, such as walking speed, which did not change in this period. Interim. This finding can be associated with another finding in the same study, in which the S-LANSS pain scale score recorded a constancy of this symptom in the 4th month, thus suggesting the relationship between physical strength and pain perception, as walking speed did not change in the 3rd and 4th months. The S-LANSS pain scale score also did not change significantly in the months in question[23].

Other studies also point out the relationship between the persistence of pain and muscle weakness since both symptoms are among the most common after COVID-19 infection, as some authors point out: “The most frequent symptoms are tiredness or fatigue (98%), myalgia (85%), joint pain (74%), [...]”[24] and also: “[...] the presence, three months after the diagnosis of COVID-19, of chest pain, dyspnea, anxiety/depression, Post Traumatic Stress Disorder (PTSD), fatigue/muscle weakness and impaired health-related quality of life [...] were significant predictors of impaired health-related quality of life 6–7 months after COVID-19 diagnosis”[25]. Furthermore, this is confirmed by a prospective and descriptive study, where the authors analyzed musculoskeletal signs and symptoms during the recovery phase of the disease and found that muscle pain is also among the most frequently found in the evaluated population, adding up to 97.5% of the percentage[26]. Next, data on muscle strength were collected, stating that only 30% of participants maintained normal strength after infection. In other words, these findings highlight the connection between these two variables analyzed in this study since the majority of this population with persistent post-COVID-19 symptoms reported musculoskeletal pain, and the percentage of participants with a deficit in physical strength was also high. Considering it is the same sample, it is suggested that most individuals with musculoskeletal pain also suffer from weakness in muscle strength.

A study evaluating 206 hospitalized patients diagnosed with COVID-19 carried out at the University of Health Sciences, Şişli Hamidiye Etfal Training and Research Hospital, Istanbul, Turkey (TŞ), found that patients who had experienced chronic pain in a specific region before COVID-19 reported worsening of pain during infection when compared to the pre-infectious state. The study found that 40.7% of patients had already complained of pain for at least three months before the infection, increasing to 82.5% during the infection and 55.1% after COVID-19. Furthermore, the physical component was impaired in patients with persistent pain after COVID-19 compared to those who did not have pain after the disease(27).

Using a sample of 530 interviewees, another study described the main functional limitations found in activities such as carrying groceries (36.2%), climbing a flight of stairs (35.5%), and bending/kneeling/squatting (38.1%), even in people with a healthy pre-infection state, showing that, although they have not experienced severe acute infection, they are not immune to facing long-term effects after the virus(28).

According to scientific literature, health professionals should focus on increasing knowledge regarding significant predictors of compromised health-related quality of life in post-COVID-19 patients, especially the prevalence of fatigue/muscle weakness and the persistence of pain, whether musculoskeletal or of another nature, in order to develop preventive measures for at-risk patients and rehabilitative measures for post-infected patients.

CONCLUSION

The results of this study highlight the influence of post-COVID-19 musculoskeletal pain on limiting functionality, showing a direct association with reduced functional capacity and muscle strength. The persistence of these symptoms impacts not only on daily activities, but also on health-related quality of life. This analysis reinforces the importance of understanding and addressing relevant predictors, such as muscle fatigue and pain persistence, to develop effective preventive and rehabilitative strategies for post-COVID-19 patients.

Conflict of Interest: The authors declare no conflict of interest.

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